PETROLOGY OF IMPACT MELT RICH MARTIAN REGOLITH BRECCIA NORTHWEST AFRICA 7475.

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Introduction: Northwest Africa 7475, an 80.2 g stone, shares compositional, isotopic, and petrographic similarities with the "unique martian basaltic breccia" NWA 7034 and impact breccia NWA 7533 [1–6]. A low degree of terrestrial alteration of NWA 7475 allows the study of martian regolith components.

Results: In a thin section of NWA 7475, we analyzed ~30 clasts 0.5-4 mm in size set in a clastic, black matrix of particles <5 µm. Most of these clasts exhibit accreted 5–40 µm thick mantles of concentrically aligned matrix particles; a 5 mm diameter, multiply layered, accretionary lapillus occurs as well [2]. Ca. 20% of the clasts are mineral fragments of plagioclase, alkali feldspar, and pyroxenes, including such with up to 5 µm-thick diopside exsolution lamellae that indicate plutonic provenances. These clasts commonly exhibit brittle deformation with planar fractures in feldspar, and fracturing and mechanic twinning in pyroxene, which indicate shock pressures of 5–20 GPa [7–8]. A few polymineralic clasts consist of shock blackened pyroxene and plagioclase that are associated with shock melt veins. Two clasts are siltstones composed of rounded feldspar and pyroxene grains cemented by Fe oxides. Crystallized melt clasts have sub-ophitic to granular and poikilitic textures of 5–30 µm size pyroxene and plagioclase crystals, while ilmenite, pyrite, magnetite, chlorapatite, and zircon are minor and accessory phases. Ca. 2/3 of the crystallized clasts contain angular fragments of feldspar and pyroxene, which suggests they are impact melt rocks; a fraction of the remainder may represent basaltic rocks. The dominant clast type is a clast-free to clast-rich vitrophyre with round, dumbbell-, amoeboid-, or shard-shapes. Amoeboid vitrophyre clasts often have contacts with the clastic breccia matrix that imply emplacement while they were molten. Phenocryst phases in vitrophyres comprise ~5–50 µm pyroxene, plagioclase, chlorapatite, magnetite-maghemite, and pyrite crystals that contain up to 2.8 wt% Ni. Ca-carbonate was found as a rim on one vitrophyre.

Summary: Petrographic and geochemical data characterize a clan of martian regolith breccia meteorites [1–5]. The juxtaposition of rapidly quenched impact melts with such that were slowly crystallized suggest NWA 7475 records more than one impact event on Mars [2]. Analogous to terrestrial accretionary impact lapilli, a water saturated impact plume can be inferred for the origin of such accretionary particles in NWA 7475 [2, 9–11].

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